

REMARKS

Applicants appreciate the thoroughness with which the Examiner has examined the above-identified application. Reconsideration is requested in view of the amendments above and the remarks below.

Abstract objection

The Abstract has been amended to contain less than 150 words.

Drawing objections

Fig. 2 has been amended to identify parallel array elements as "16a" to distinguish them from mask opaque segments 16. The specification has been correspondingly amended on page 11.

With respect to the absence in the drawings of element 40, the paragraph of the specification beginning on page 12 has been amended to change the reference sign to "40a, 40b, 42a, 42b, 44a, 44b."

Applicant is unable to locate the reference in the specification to the drawing element "20a" or "P."

Claim objections

Responsive to the objections to the claims, applicant has amended the claims as follows.

Claim 1 has been amended to add "each" as suggested by the Examiner.

In claims 1 and 7, applicant has restated the limitation that, after lithographic printing, width of the printed second portion is sensitive to dose but not focus of the energy beam. Support is shown on page 13, lines 8-12.

Claims 3, 4, 9 and 12 have been amended as suggested by the Examiner.

Claim 13 has been cancelled.

Claim 22 has been amended to refer to the target of claim 14, in which the elements are electrically conductive.

Rejection under 35 USC § 112, second paragraph

Responsive to the rejection of the claims under 35 USC § 112, second paragraph, applicant has amended the claims as follows.

Claims 1, 7, 11, 17 and 20 have been amended to replace "and/or" with "and."

In claims 1, 7, 11 and 14, the term "may be" has been replaced with "can be."

In claim 1, "the" has been added to the term "edges of outer elements on each side of and farthest from the central element" to make it clear that these are ones of the "spaced, substantially parallel outer elements" previously recited. Accordingly, the objected-to limitation, "said outer elements" refers to the "spaced, substantially parallel outer elements."

Finally, in claim 11, applicant has chosen to use the term "array edges" to refer to the edges along the length of the single element. While "array" often refers to a plurality of items, the dictionary definition is not so limited. Further, as explained in the specification at page 14, lines 10-22, the preferred embodiment of the lithographically printed second target portion is formed from a plurality of individual elements in the mask. Therefore, it is not believed contrary to the normal meaning to refer to "array edges" as applicant has done for clarity.

Rejection under 35 USC § 102

Claims 1-5, 7-13 and 17-23 stand rejected under 35 USC § 102 as being anticipated by Bakeman U.S. Patent No. 5,952,160. Applicants respectfully traverse this rejection.

Broadly speaking, the present invention is directed to a metrology target mask which may be used to determine proper dose and focus in a lithographically formed pattern, having a first mask portion sensitive to both dose and focus, and a second mask portion sensitive to dose but not focus (independent claims 1 and 7), a target having the same function (independent claim 11), and a method of using the aforementioned mask and measuring the resulting target to determine proper dose and focus (independent claims 20 and 22). The first mask portion uses a first array of elements that, when printed, are resolvable, since they have element length and spacing which is dose and focus sensitive. For clarity, applicants have added the limitation to claims 1, 7 and 11 that the pitch of the first array of elements is selected so that they are resolvable after printing, and claim 13 has been cancelled. The second mask portion uses a second array of elements in which outer elements are not resolvable after lithographic printing, so that the width of the printed target from this portion sensitive to dose but is not sensitive to focus. Accordingly, upon printing and measuring the widths of the printed first and second target portions, the dose and focus of the energy beam may be determined for the lithographic processing of the layer being exposed and etched in the printing process.

The cited Bakeman patent is not directed to measuring and determining proper dose and focus of the energy beam, but to actually "reducing, eliminating, or even reversing" the mask pattern-dependent bias that occurs during lithographic printing, by

exposing the mask to both focused and defocused beams (column 5, lines 14-19). Bakeman mentions the use of a pattern 82 which is depicted in Fig. 4a as having two sets of parallel lines, with one set being perpendicular to the other. However, there is no disclosure or suggestion that these sets of lines are created so that one set is both dose and focus sensitive, and the other set is dose, but not focus, sensitive. Bakeman merely refers to pattern 82 as "grouped lines" (column 5, line 49), with no teaching as to their length, spacing or pitch. In fact, in the subsequent discussion, it is clear that all of the lines in the pattern are subject to similar degrees of resolution since, at sufficient defocus, the pattern simply becomes a grey scale transmission mask "with each pattern having an optical transmission in proportion to its ratio of chrome to glass" (column 5, lines 52-53). Bakeman therefore teaches away from the claimed invention since applicants' claimed first target portion elements are resolvable at the same time that the outer elements of the second target portion are not resolvable. Thus, the patterns described by Bakeman cannot be used to create printed targets in which a first portion is both dose and focus sensitive, and a second portion is dose, but not focus, sensitive, as applicants claim.

Further, Bakeman includes no teaching of the manner of creating applicants' claimed two mask portions, which in turn create the claimed two target portions. In particular, Bakeman does not disclose applicants' second target mask portion as described in claims 1 and 7, which contains outer elements which are not resolvable after lithographic printing, such that the width of the target second portion may be measured to determine dose of the energy beam used in the lithographic processing. Likewise, the spacing of the first applicants' claim 13 Bakeman makes no mention of creating a mask

having a portion in which outer elements are intentionally not resolvable, and then using the printed target to determine the dose of the energy beam by measuring the width of that portion.

Applicants' claims 3 and 9 states that pitch between elements of the array in the second mask portion is less than the resolution limit of the energy beam used to expose the mask in the lithographic processing, and is not disclosed in or obvious from Bakeman. The portion of Bakeman cited by the Examiner for this limitation, column 5, lines 43-47, does not refer to the actual configuration of the pattern 82 in Fig. 4a, since Bakeman states that the energy beam must be intentionally defocused to create the gray scale effect (column 5, lines 50-51). This means that the energy beam is able to resolve the lines, without defocusing.

Applicants' claim 4 describes decreasing width of the second mask portion outer elements with distance from the central element. This is nowhere described in Bakeman, including the cited Fig. 4a.

With respect to the claimed embodiment of the second target mask portion in applicants' claim 7, the Examiner describes a construct of various portions of Bakeman's grouped lines 82 in Fig. 4a. However, there is no teaching or suggestion in Bakeman that the pitch of the so-called outer elements is selected so that they are not resolvable after printing. In Bakeman, the elements are not resolvable because the energy beam is intentionally defocused (column 5, lines 50-51), which causes all the lines to be unresolved. Again, Bakeman teaches away from the claimed invention since applicants'

claimed first target portion elements are resolvable at the same time that the outer elements of the second target portion are not resolvable.

The subject matter of applicants' claim 10 is also not disclosed or suggested by Bakeman, since Fig. 4a does not show the tapering as hypothesized by the Examiner.

Method claims 17-23 are likewise not anticipated by or obvious from Bakeman since he does not disclose or suggest measuring the widths of the first and second portions of the resulting printed targets to determine dose and focus of the energy beam during lithographic processing.

Rejection under 35 USC § 103

Claim 6 stands rejected under 35 USC § 103 as being obvious from Bakeman. Claims 14-16 stand rejected under 35 USC § 103 as being obvious from Bakeman in view of Chan U.S. Patent No. 5,998,226. Applicants respectfully traverse this rejection.

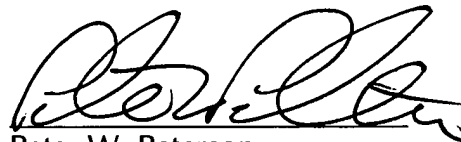
Claim 6 is not obvious for the same reasons given in connection with claim 1, and further that there is nothing in Bakeman, or any other reference cited by the examiner, that would suggest using transparent first and second elements with resolvable first target portion and a second target portion having elements that are not resolvable.

Claims 14-16, and 22-23 as now amended, are directed to the same target portions and methods of using the target portions as previously described, except that the target elements are electrically conductive so that a current may be applied across the arrays and voltage may be measured to determine resistance of each, and therefore dose and focus of the energy beam. Chan is directed to electrically alignment between via and interconnect layers, and is not directed to electrically measuring first and second target portions to

determine proper dose and focus of the energy beam and printing process. Since Bakeman does not disclose the limitations of applicants' target mask, printed target, and method of using the mask and target to determine proper dose and focus, and since Chan does not remedy the deficiencies of Bakeman, the combination of the two does not *prima facie* render applicants' claims obvious to one of ordinary skill in the art.

It is respectfully submitted that the application has now been brought into a condition where allowance of the entire case is proper. Reconsideration and issuance of a notice of allowance are respectfully solicited.

Respectfully submitted,

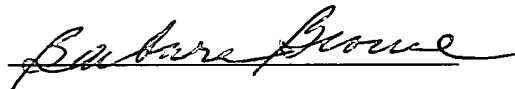


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